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DOUGLAS COUNTY, OREGON:
POTENTIAL ECONOMIC IMPACTS OF A CHANGING TIMBER RESOURCE BASE

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ABSTRACT

Available projections for Douglas County show that timber harvest from private lands is expected to decline. Forest Service and Bureau of Land Management timber harvest may change over time as priorities and funding change. Identification of the local economic impact of changes in timber harvest is necessary for planning to adjust to projected impacts. An input-output technique was used to estimate for each local sector the impact of the following on sales: Change in demand for forest products; change in Forest Service or Bureau of Land Management appropriations; changes in private, Forest Service, or Bureau of Land Management timber harvest; and a decline in private harvest offset by an increase in Forest Service and Bureau of Land Management harvest. The model used in the analysis can be used to test the effectiveness of new industries, or changes in existing industries, in offsetting projected impacts of changes in timber-oriented industries or agencies.

KEYWORDS: Resources (forest), forest product industry development, economics (forest products industries).

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BACKGROUND

The timber harvest in Douglas County, Oregon, is projected to decline. A reduction in private timber harvest within the next 10 to 20 years can be expected because current harvest rates are based primarily on old-growth inventory. The total inventory of young growth and old growth is being reduced more rapidly than inventory is being replaced. This trend is occurring in the Douglas-fir region as a whole as well as southwestern Oregon and Douglas County.

A U.S. Forest Service study (1969) found that continuation of current trends of private log production in western Oregon and southwestern Washington would lead to a 65-percent reduction in private harvest by the year 2000. The study also found for southwestern Oregon that merchantable timber from private industrial lands would be exhausted in 30 to 40 years if present levels of private cutting and timber management were continued. After that time, only trees in the lowest merchantable-size class would be available for cutting. We would expect firms to reduce timber harvest from their own lands before complete inventory depletion in order to maintain a degree of control over timber supply.

A study by Hamill (1963) showed for Douglas County that maintained harvest rates on private lands in the county would rapidly deplete inventory on these lands. Annual timber harvest on private lands with a "conservative" rate of timber harvest for the period 1960 to 1970 was projected to be 799.8 million board feet, Scribner scale. Actual harvest during this period averaged 699 million. According to Hamill, a conservative rate of timber harvest would reduce privately owned sawtimber inventory from 19.2 billion board feet in 1960 to 10.8 in 1970 and 7.3 in 1980.

More recent projections for Douglas County are not available. However, the more recent Forest Service study tends to confirm Hamill's conclusion. A declining timber harvest can be expected on private lands in Douglas County. The rate of decline will depend on individual landowners' decisions over the coming years.

A decline in timber harvest will cause adjustments by firms in both timber and nontimber industries in the county. Information on the impacts of changes in timber harvesting and processing is necessary for firms, individuals, and county planning organizations to better plan adjustments and to offset the consequences of a declining timber harvest.

A study by Youmans et al. (1973) used an input-output model to identify linkages between industries within the county and between the county economy and the rest of the world. The purpose of this report is to use this model and other background information to identify both the role of timber in the Douglas County economy and the impact of changes in timber harvesting and processing on the Douglas County economy.

THE SETTING: TIMBER HARVESTING AND PROCESSING PATTERNS IN DOUGLAS COUNTY

The model of the Douglas County economy developed by Youmans et al. (1973) does not identify the volumes of forest products consumed and produced in Douglas County, nor the origins and destinations of raw material produced in the area. The input-output model measures flows of products and raw materials in terms of dollars rather than volumes. The purpose of this section is to provide perspective on timber harvesting and processing patterns in the area.

TIMBER HARVEST

Over the decade of the 1960's, total timber harvest in Douglas County increased from about 1 billion board feet, Scribner scale, in 1961 to well over 1.5 billion by the end of the period (fig. 1). There have been cyclical fluctuations in log production which are characteristic of the forest products industry.

Private lands accounted for about 45 percent of timber harvest in the early 1960's and about 50 percent by the end of the decade. The projected decline in timber harvest in the county will be on private lands.

Harvest on public lands is limited by administrative regulations and over the next 30 years should not decline because of reductions in inventory on these lands. However, changes in harvest regulation policies or changes in land use classification could lead to reductions in timber harvest on public lands as well. For example, areas classified as wilderness would reduce the resource base for timber production.

Any decline in timber harvest in Douglas County will be reflected through the timber harvesting, transporting, and processing industries which are dependent on Douglas County timber. Replacement of the harvest reduction by imports from other areas does not appear likely because the anticipated decline in private log harvest is general to all of southwestern Oregon.
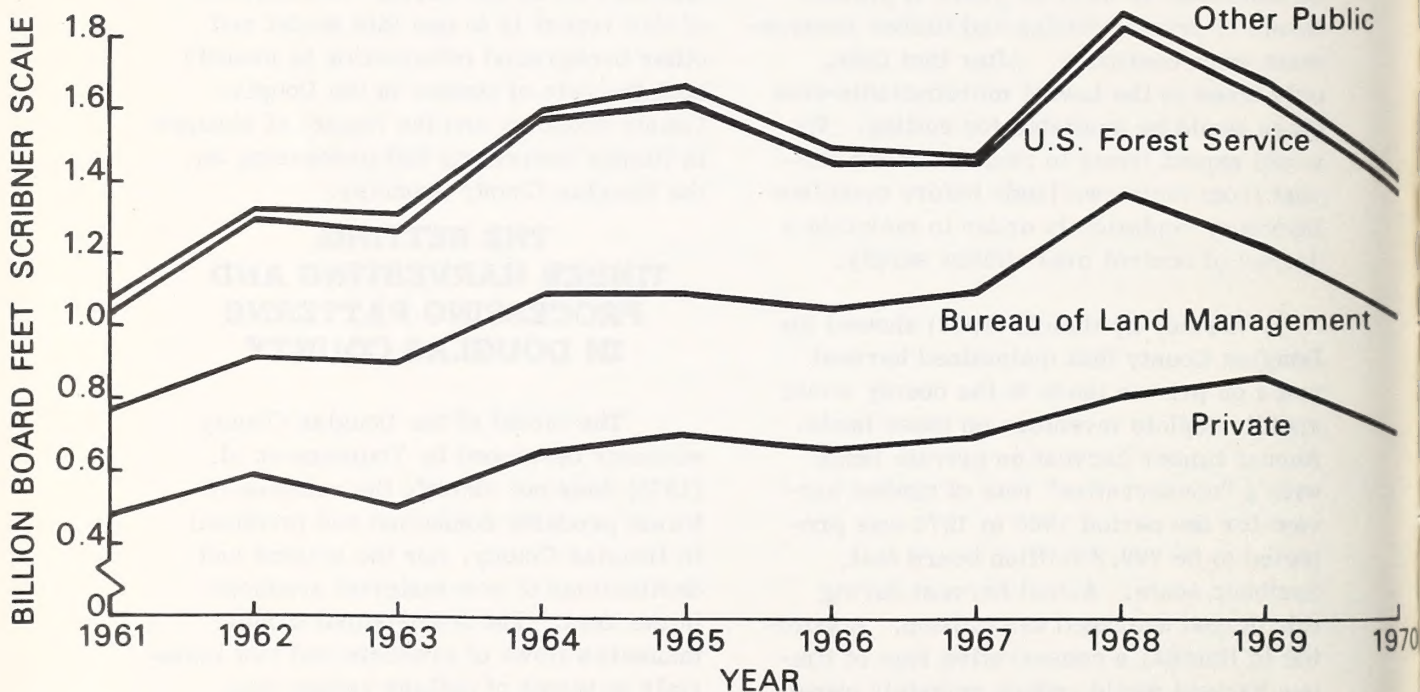
Figure 1.--Douglas County timber harvest by ownership, 1961-70.

LOG FLOWS IN THE DOUGLAS COUNTY AREA

In 1968, Douglas County produced and sold in Oregon 1.4 billion board feet, Scribner scale, of logs (Manock et al. 1970). Export of logs produced in Douglas County to other States is negligible because of the geographic location of the county and the transportation pattern in the area. In 1968, there were 71.7 million board feet of logs exported from Coos Bay, Oregon, to foreign countries. Some of these logs originated in Douglas County, but in terms of timber harvest, foreign exports were a minor portion of the total. Even if all the exports from Coos Bay had originated in Douglas County in 1968, they would amount to only 4 percent of total timber harvest. Industry in the county consumed 1 billion board feet, or 70.7 percent of the total county timber harvest, and the remainder was exported to nearby counties. The adjacent counties of Lane and Jackson are the major Oregon export markets for logs produced in Douglas County:

Destination	Log volume originating in Douglas County (Percent)
Douglas	70.7
Lane	16.8
Jackson	7.8
Coos	2.4
Linn	1.3
Josephine	1.0
Total	100.0

A total of 1.1 billion board feet of logs was consumed in Douglas County in 1968, and 88.1 percent came from the county:

Origin	Log volume consumed in Douglas County (Percent)
Douglas	88.1
Josephine	4.3
Jackson	2.5
Lane	1.9
Curry	1.7
Coos	1.5
Total	100.0

A decline in timber harvest in Douglas County would cause some adjustment by the timber industries which import or export logs from the area. If the 1968 pattern holds, Lane, Jackson, and Josephine Counties would be the other areas in the State affected most by a decline in timber harvest in Douglas County.

TIMBER PROCESSING

In 1968, the forest products industry which processed logs in Douglas County consisted of the sawmill, veneer and plywood, and shake and shingle industries. The veneer and plywood industry accounted for 52.1 percent of the total volume of logs consumed; the sawmill industry, 46.9 percent; and the shake and shingle industry, 1 percent.

The three pulp and particleboard mills in Douglas County in 1968 consumed only mill residues. Reductions in timber harvest could affect their fiber supply by a decrease in available residues.

Impacts on the timber harvesting, transporting, and processing industries caused by a reduction in timber harvest will be felt by other industries in the county. The input-output model of the

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Douglas County economy provides a means to trace the impacts of changes in purchases of goods and services and sales of products by forest products industries in Douglas County.

The following section of this report presents background information on using an input-output model and on the forest products industries in the Douglas County model.

THE TIMBER SECTORS IN THE DOUGLAS COUNTY INPUT-OUTPUT MODEL

INTERPRETING DATA
FROM THE STUDY

Three tables from the study by Youmans et al. (1973) provide the necessary information to evaluate economic flows in the county. Table 1 shows the transactions which occurred between industries in Douglas County in 1970 and between each industry in the county and the following: Imports, exports, State and Federal Government, and depreciation and inventory depletion accounts.

Industries, also known as sectors, 1 through 32 are considered to be inside the county (internal sectors) and sectors 33, 34, and 35 are considered to be outside the county (external sectors). The general criterion was that for a sector to be internal, firms or organizations in the sector have decisionmaking units located in Douglas County and make decisions which apply directly to the Douglas County economy. For example, the City of Roseburg is an internal sector, but State and Federal Government is an external sector. The distinction between internal and external sectors is important in an input-output model because payments from internal to external sectors are considered "leakages" to the economy. These leakages (expenditures) are not

recirculated within the economy in the same manner that a payment from an internal sector to an internal sector would be.

Each column shows the amounts of expenditure by the industry to each of the other industries in the county and to external sectors. For example, the table shows that in 1970, sector 2, sawmills, spent a total of $42,765,593. Of this total, $14,043,477 was used to purchase goods and services from the timber harvesting and hauling industry.

Each row of table 1 shows the sales of any one sector to each of the other sectors in the model. For example, row 2 of table 1 shows that the sawmill industry had total sales receipts of $42,765,593 which were equal to total expenditures. In this input-output model, receipts must equal expenditures for each industry in the county. The sawmill industry did not sell anything to the timber harvesting and hauling sector and sold $150,000 of goods and services to other firms in the sawmill sector.

Table 2 is based on table 1. The table is interpreted by reading down each column. Each entry in each column of the internal sectors was divided by the corresponding total expenditures of each column. Each column in table 2 adds to a total of 1 and shows in a sense how each industry spends an "average" dollar of expenditures. For example, per dollar of expenditure, the sawmill industry spent 32.8 cents for goods and services from the timber harvesting and hauling industry. The input-output model assumes that if the sales of the sawmill industry were to increase, firms in this industry would increase their purchases from the timber harvesting and hauling sector by 32.8 cents for each dollar of sales increase.

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Table 1.--Transactions matrix showing interindustry flows in dollars, Douglas County, Oregon, 1970

Sector number and sector	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(19a)	(20)	(20a)	(21)										

Table 2.--Direct coefficient matrix showing 1970 proportion of each industry's expenditures by sector

Sector number and sector	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(19a)	(20)	(20a)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
1) Timber harvesting and hauling	0.02392	0.32838	0.04713	0.00641	0	0	0.00072	0	0	0.00320	0	0	0	0.00023	0	0.00010	0	0.00013	0.00052	0	0	0.00565	0.01590	0.02993	0.03351	0	0	0	0	0	0	0	0.00020	0
2) Sawmills	0	.00351	0	.00573	0	.00072	.00044	.00320	0	0	0	0	.00001	.00010	0	.00210	.00943	0	.00034	0	.02303	.00019	.04648	.00013	0	0	0	0	0	0	.00151	0		
3) Plywood and veneer mills	0	.00633	.00699	0	0	0	0	0	0	0	0	0	0	0	.00102	0	0	.11362	.00200	.11482	.00163	0	0	0	0	0	.00408	0						
4) Pulp, paper, particleboard plants	0	0	0	0	0	0	0	.00009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5) Commercial fishing	0	0	0	0	.01176	0	0	.07976	0	0	0	0	0	0	0	.00030	0	0	0	0	0	0	0	0	0	0	.00018	.01330						
6) Horticulture	0	0	0	0	0	0	.00411	0	0	0	0	0	0	.00002	0	.00064	0	0	0	0	0	0	0	0	0	.00082	.00077						
7) Livestock	0	.00091	0	0	0	.00655	.08811	.00454	0	0	.00038	0	0	.00092	0	.00062	.00649	0	0	.00374	0	0	0	0	0	.00452	.00583						
8) Manufacturing	.01970	0	0	0	0	0	0	.00463	.00550	.04362	.00407	0	0	.00536	0	.03505	.00205	0	0	.00025	0	.00578	0	.00021	.00110	.00083	.00068	.00861	.02060				
9) Lodging	0	0	0	0	0	0	0	.00097	0	0	.00107	0	0	0	.00001	0	0	0	0	.00001	0	.00015	0	.00794	.00110	.00567	.00262	.04713	.0712				
10) Cafes and taverns	0	0	0	0	.00121	0	0	0	0	.00107	0	0	0	0	0	0	0	0	.00001	0	.00015	0	.00794										
11) Service stations	.02523	.00420	(1/)	(1/)	.00082	.19242	.00310	0	0	.00047	.03541	.00275	.00001	0	0	.02483	.00098	.00330	0	.00853	0	.00908	.00250	.01330	.00263	.00131	.00020	.00233	.00341	.00341		.00580	.06788	.24739
12) Automotive sales and service	.09668	.01301	.00208	.00051	.00348	.07242	.00616	.00501	.00104	.00449	.02667	.01598	.02160	.00348	(1/)	.04557	.00155	.01619	0	.00374	0	.00626	.00529				.00317						
13) Communications and transportation	.03390	.01497	.00497	.00415	.00957	.05729	.00934	.00522	.11877	.04100	.01311	.01452	.01311	.01886	.01045	.01459	.02913	.01035	0	.00757	0	.00056	.01004	.02366	.02304	.00892	.00271		.00096	.00092	.00469		.06054	
14) Professional services	.0047.	.00084	.00023	.00074	.00136	.00069	.01010	.00035	.00653	.00724	.00170	.00098	.00082	.01711	.00120	.00220	.00135	.00242	0	.01589	0	.00216	.02028											
15) Financial services	.04230	.12601	.01772	.00124	0	.21444	.19482	.01415	.23723	.05177	.02173	.01179	.00377	.03277	.00360	.01363	.00705	.00547	0	.16700	0	.00578	.04745	.00069	.36287	.12667	.09440	.02565	.10443	.11471				
16) Construction	.00295	.00173	.02505	.00787	.00179	.01337	.01203	.00226	.02926	.02929	.00156	.00062	.00080	.00546	.02451	.12539	.00102	.00213	0	.03066	0	.00583	.05031	.04448	.0806	.03320	.01220							
17) Retail and wholesale trade	.03035	.04487	.01948	.02750	.22322	.24539	.27975	.02457	.08554	.10633	.00624	.00118	.00399	.02515	.00560	.04121	.03929	.01098	0	0	0	0	0											
18) Retail services and organizations	.01069	.00220	.00104	.00097	.08393	.10293	.10729	.00496	.25563	.02747	.00541	.01333	.00412	.04621	.01309	.01354	.00474	.00777	0	.00346	0	.00466	.02191	.01116	.01447	.02659	.04465							
19) U.S. Forest Service sales	.01019	.03830	.06434	0	0	0	.00390	0	0	.00425	0	0	(1/)	0	0	.00013	(1/)	(1/)	0	0	0	0	0	0	0	0	0	0	0					
19a) U.S. Forest Service appropriations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.00010	(1/)	.00003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.00007	.00017
20) Bureau of Land Management sales	.05607	.08493	.06865	.00024	0	0	.00061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
20a) Bureau of Land Management appropriations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.12832	0	.07308	0	.00384	0	0	0	0	.00289	.00269	.04193	.03955			
21) Education	.00623	.00880	.01290	.01643	.00115	.00138	.00546	.00476	.00600	.00148	.00027	.00076	.02617	.00238	.00054	.00156	.00987	.00065	0	0	0	0	0	.00301	0	0	0	0	.02220	0				
22) Law enforcement	.00001	.00019	.00014	.00023	.00001	.00001	.00006	.00016	.00051	.00021	.00009	.00001	.00026	.00098	.00001	.00002	.00011	.00007	0	(1/)	.04392	0	.02501	0	0	0	.02081	.00486	0	.00463	0			
23) County roads	.01652	.01605	.00535	.01731	.00001	.00001	.00006	.00005	.00006	.00002	(1/)	.00001	.00026	.00002	.00001	.00002	.00018	.00009	0	(1/)	0	0	0	0	0	0	0	.00031	.00755	.00085	0			
24) Social services	.00001	.00004	.00010	.00010	.00001	.00001	.00006	.00005	.00068	.00036	(1/)	.00001	.00026	.00032	.00001	.00052	.00013	.00013	0	0	0	0	0	0	0	0	0	0	0	0				
25) Administration	.00069	.00070	.00032	.00082	.00130	.00001	.00006	.00012	.00006	.00002	(1/)	.00001	.00026	0	0	.00060	.00257	.00054	0	0	0	0	.00018	0	0	0	0	0	0	0	.00140	0		
26) City of Roseburg	.00013	.00067	.00195	.00192	0	.00021	.00102	.00105	.00297	.00110	.00039	.00019	.00568	.00082	.00006	.00005	.00038	.00012	0	0	0	0	.00018	0	0	0	.01031	0	.00133	0				
27) City of Sutherlin	.00002	.00013	.00031	.00028	0	.00003	.00015	.00013	.00162	.00066	.00022	.00008	.00073	.00006	.00002	.00010	.00044	.00012	0	0	0	0	.00011	0	0	0	0	.03164	.00011	0				
28) City of Myrtle Creek	.00008	.00011	.00032	.00025	.00002	.00003	.00028	.00028	.00224	.00062	.00028	.00008	.00071	.00024	.00001	.00006	.00036	.00015	0	0	0	0	.00053	0	0	0	0	0	0	0				
29) City of Reedsport	.00002	.00009	.00022	.00022	0	.00002	.00013	.00010	.00106	.00044	.00014	.00005	.00060	.00035	.00002	.00006	.00083	.00128	0	0	0	0	0	0	0	0	0	0	0	0				
30) Other incorporated cities	.00003	.00040	.00047	.00040	0	.00004	.00021	.00039	.00220	.00220	.00039	.00003	.00109	.00009	.00002	.00007	.00083	0	.50487	0	.74389	0	.64953	.76470	.28493	.57539	.45803	.32243	.13484	.10184	.19563	.29640	0	
31) Households	.28678	.22121	.28667	.11255	.39945	.17587	.12408	.29802	.12460	.11235	.26510	.49909	.08504	.20711	.15287	.25344	0	.50487	.07495	.23615	.02407	.18674	.12712	.04705	.23244	.13923	.28315	.45382	.46564	.50542	.16771	.28142	.00105	0
32) Visitors	0	0	0	0	0	0	0	.00534	0	.30109	.73264	.79530	.43055	.17408	.80642	.42283	.66136	.62817	0	0	.68661	0	.05943	.00663	.02731	.05666	.07934	.09286	.14319					
33) Imports	.21030	.00030	.36934	.77565	.22164	.02691	.02872	.60162	.00534	.04546	.01686	.10211	.09283	.12006	.02555	.03220	.02827	.02402	.61051	0	0	0	0	0	0	0	0	.01473	0					
34) State and Federal government	.04262	.03578	.04566	.00330	.01575	.00388	.01465	.05730	.02312	.03558	.01762	.12719	.04710	.02060	.04282	.01955	.02412	0	0	0	0	0	0	0	0	0	0	0	0					
35) Depreciation and inventory depletion	.07847	.04449	.01857	.01520	.02303	.02741	.08562	.00840	.08371	.03558	.00823	.01762																						

1/ Does not add up to 0.00001 due to rounding.

In table 2, the entries in each column are a measure of the direct economic impact of each industry on other industries in the county. However, the increased purchases of sawmills from timber harvesting and hauling cause this latter industry to increase its purchases, including purchases from industries who buy from sawmills. In this manner, the total impact of the sawmill industry will be more than the initial direct impact. The total impact on the economy will be more than the sum of the direct impacts for all the industries. These total impacts are referred to as the direct and indirect impacts.

Table 3 is based on table 2. The various columns show for each industry the direct and indirect impact per dollar of sales outside the county. For example, for each dollar of sales to final demand the direct and indirect impact of the sawmill sector on the timber harvesting and hauling industry is $0.345 (column 2, row 1). This consists of the direct impact of $0.328 plus the indirect impact of $0.017. The direct and indirect impacts of a $1 change in sawmill sales outside the county on all the internal sectors in the economy sum to $3.09. This consists of the direct impact of $1.00 plus the indirect impact of $2.09. The importance of sales outside the county in interpreting impacts derived through input-output analyses will be discussed later.

THE TIMBER SECTORS

In the Douglas County input-output model, four sectors were delineated to indicate timber processing. In the following sections of the report, a number following the name of an industry indicates the industry's sector number. For example, the timber harvesting and hauling industry (1) is synonymous with sector 1. Firms which process logs or wood fiber were classified as being in sectors 2, 3, or 4, depending on whether the largest portion of each firm's sales came from the sale of sawmill lumber and products (2), plywood and veneer products (3), or pulp, paper or particleboard products (4). The products or services provided by firms in other industries are listed in appendix A.

In addition to firms in sectors 1 through 4, the Forest Service (19 and 19a), and the Bureau of Land Management (20 and 20a) have an impact on the forest industry in Douglas County because they sell stumpage. Sectors 19 and 20 show the sales activities of these agencies, and sectors 19a and 20a show the expenditures made with appropriated funds. Stumpage also comes from sources other than the two Federal agencies. Some firms in sectors 1, 2, 3, and 4 own forest land and sell stumpage or process the timber in their own operations. Some individuals in households (31) own forest land and sell stumpage. Logs are also imported from firms or agencies located outside the county.

A firm, organization, or household was considered to be inside the Douglas County economy if the decisionmaking unit was located in the county. Although portions of several National Forests are located in Douglas County, only the Umpqua and Siuslaw National Forests had Ranger Districts headquartered within the county borders in 1970. For the purposes of this study, the U.S. Forest Service (19 and 19a) is considered to be the Umpqua National Forest and the Smith River District of the Siuslaw National Forest. Similarly, only the Roseburg District of the Bureau of Land Management is included in sectors 20 and 20a, even though some lands administered by the Coos Bay and Medford Districts are located in Douglas County.

Our input-output model of the Douglas County economy does not identify sources of logs or stumpage consumed in the county. Firms and individuals in sectors 1, 2, 3, 4, and 31, the U.S. Forest Service (19 and 19a), the Bureau of Land Management (20 and 20a), and firms and agencies located outside the county but selling products in Douglas County carry on activities other than just timber management and stumpage and log sales. Because of this, we cannot specifically identify the flow of dollars caused by timber sales and processing within the county. However, sectors 1 through 4 and 19 through 20a are heavily dependent on timber, and major changes in these sectors will be due to changes in the timber situation in Douglas County.

EVALUATING AN INDUSTRY'S ECONOMIC IMPACT

IMPACTS ATTRIBUTABLE TO CHANGES IN DEMAND

In the input-output model, exports from an economy form the basis for sustaining economic activity within the area. This "new money" starts in motion a chain of interindustry sales, sustains employment, and is the basis for support of the local service industry. In the input-output terminology, exports and other sources of money from outside the county are termed the final demand component for a sector. The input-output model attributes sales activity in the county to those industries which have sales to final demand. The need for sales outside the county arises because the county is not self-sufficient. Industries and people in Douglas County purchase such imports as machinery and food products to process county resources and provide services to residents of the county. Douglas County must export goods and services to other areas in order to pay for these imports.

In our model of the Douglas County economy, final demand for each sector is equal to the sum of sales to exports, State and Federal Government, and inventory accumulations. Table 4 shows final demand for each internal sector. Within the model, sectors which have relatively little sales volume to final demand are dependent on other industries which have relatively more sales to final demand. For example, the fisheries industry (5) has no sales of unprocessed fish to final demand and the model would not attribute to the fisheries sector any dependency of sales in other sectors. According to the model all employment and sales in the fisheries industry are dependent on other industries in the county which do have sales to final demand. The fish caught by firms and individuals in the fishing industry are processed by canneries in the county, and the canneries sell the processed fish products. However, resources provide the basis for an area's comparative advantage, which in turn provides the basis for sales to the final demand sector. Understanding this characteristic of the input-output model is necessary to use the model for evaluating economic impacts of changes in final demand.

The link between final demand and an area's economic base has been termed a "backward" linkage (Archer et al. 1970).

IMPACTS ATTRIBUTABLE TO RESOURCE AVAILABILITY

The input-output model assumes that resources in an area are available, enabling industries to respond to changes in final demand. If a resource consumed by an industry in an area becomes scarce, the lack of resource availability could constrain the processing industry's production. For example, lack of sufficient timber supplies could reduce the output

Table 3.--Direct and indirect business coefficients matrix showing change in 1970 county sales caused by a $1 change in sales to final demand 1/

Sector number and sector	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(19a)	(20)	(20a)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
1) Timber harvesting and hauling	1.02854	0.34525	0.05452	0.00891	0.00091	0.00100	0.00115	0.00156	0.00101	0.00091	0.00030	0.00048	0.00058	0.00103	0.00115	0.00186	0.00058	0.00051	0.02024	0.01827	0.05326	0.03595	0.00145	0.00150	0.00232	0.00174								(1)
2) Sawmills	.00444	1.01134	.00649	.00646	.00164	.00229	.00238	.00407	.00202	.00182	.00055	.00045	.00107	.00187	.00273	.00183	.00113	.00091	.02463	.00392	.04822	.06271	.00274	.00267	.00526	.00353								(2)
3) Plywood and veneer mills	.01033	.02635	1.02542	.00116	.00319	.00174	.00274	.00157	.00242	.00242	.00090	.00078	.00184	.00337	.00070	.00205	.00227	.00169	.11785	.00583	11966	.00666	00434	.00507	.00263	.00408								(3)
4) Pulp. paper. particleboard plants	(2/)	(2/)	(2/)	1.00000	(2/)	(2/)	(2/)	.00009	(2/)	(2/)	(2/)	(2/)	.00001	(2/)	(2/)	.00001	(2/)	.00001	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)		.00003	.00011					(4)
5) Commercial fishing	.00275	00185	.00113	.00051	1.01394	00154	00184	.08187	00159	00491	00076	00035	00083	00199	00030	00092	00380	00094	00056	00202	00051	00213	00250	00237	00145	00190								(5)
6) Horticulture	.00054	.00062	.00052	.00023	.00083	1.00054	.00514	.00038	.00049	.00060	.00018	.00018	.00042	.00079	.00017	.00042	.00095	.00042	.00023	.00095	.00019	.00109	.00108	.00118											(6)
7) Livestock	.00129	.00242	.00104	.00045	.00213	0.00915	1.09885	.00579	.00303	.00160	.00092	.00046	.00085	.00190	.00140	.00096	.00148	.00795	.00051	.00170	.00046	.00213	.00213	.00236	.00130	.00202	.00173	.00118							(7)
8) Manufacturing	.03214	.02075	.01215	.00554	.00223	.01695	.02014	1.01300	.01791	.05855	.00864	.00367	.00878	.02191	.00323	0.399	.04125	.01023	.00612	.02209	.00564	.02263	.02746												(8)
9) Lodging	.00418	.00465	.00403	.00169	.00544	.00264	.00332	.00362	1.00333	.00425	.00165	.00143	.00338	.00617	.00117	.00314	.00220	.00307	.00185	.00683	.00152	.00870	.00788	.00949	.00571										(9)
10) Cafes and tavern	.02261	.02523	.02196	.00916	.03091	.01436	.01809	.01456	.01814	1.02407	.00902	.00782	.01845	.03368	.00636	.01714	.01184	.01677	.00988	.03598	.00031	.04770	.04308	.04627	.04063										(10)
11) Service stations	.06289	.05356	.03670	.01509	.04772	.22324	.03407	.02290	.03059	.03750	1.05093	.01515	.05658	.01976	.02973	.01722	.07031	.07031	.01511	.00452															(11)
12) Automotive sales and service	.19981	.15608	.10124	.04149	.12926	.07413	.08632	.06621	.08589	.10348	.06598	1.04930	.14458	.02827	.12612	.05187	.08655	.04836	.16411	.04316	.20714	.18718	.26136	.18464	18848									(12)
13) Communications and transportation	.08038	.07805	.04895	.02274	.07146	.12921	.05777	.03438	.16260	.08847	.03098	.02943	1.04776	.08191	.02302	.05126	.05295	.04170	.02359	.07787	.02064	.08904	.10438	10451											(13)
14) Professional services	.03344	.03440	.02805	.01234	.03889	.09009	.03495	.01870	.03078	.03650	.01313	.01081	.02396	1.05952	.00927	.02416	.01630	.02350	.01282	.06151	.01075	.05987	.05603												(14)
15) Financial services	.07325	.17489	.04736	.01351	.03693	.24161	.24097	.03325	.26336	.08148	.03374	.02131	.02549	.07306	1.01215	.02224	.02682	.01805	.04656	.04656																(15)
16) Construction	.03829	.04794	.06014	.02756	.03494	.03885	.04261	.01950	.06319	.06105	.01241	.00961	.04392	.03516	1.16306	.01545	.02106	.04054	.23013	.02872	.05793	.10093	.06474	.44249	19726	14406									(16)
17) Retail and wholesale trade	.22218	.27052	.20686	.10653	.48155	.38253	.47533	.16636	.24789	.30545	.08180	.06606	.15814	.30543	.06018	.19264	1.14171	.15217	.09392	.33779	07881	.39869	.41896												(17)
18) Retail services and organizations	.06110	.06229	.04850	.02106	.14807	.14072	.16228	.04312	.30094	.07799	.02512	.02999	.04314	.11723	.02698	.05248	.03055	1.04358	.02485	.08128	.02029	.10054	.11164	.11744											(18)
19) U.S. Forest Service sales	.01146	.04414	.06695	.00048	.00050	.00035	.00470	.00040	.00464	.00041	.00015	.00013	.00030	.00055	.00022	.00091	.00029	.00030	1.00881	.00010	.01015	.00125													(19)
19a) U.S. Forest Service appropriations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00000	0													(19a)
20) Bureau of Land Management sale	.05873	.10710	.07405	.00133	.00046	.00040	.00116	.00057	.00044	.00042	.00014	.00013	.00028	.00051	.00036	.00156	.00030	.00028	.01134	.00184	1.01531													(20)
20a) Bureau of Land Management appropriations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00000												(20a)
21) Education	.03686	.05212	.05051	.02656	.03423	.02176	.02930	.02045	.03008	.02766	.00999	.00916	.04555	.03754	.00750	.02062	.02348	.01822	.14293	.03792	.08665	.04886	1.04696	.05208											(21)
22) Law enforcement	.00125	.00158	.00133	.00073	.00164	.00087	.00110	.00095	.00156	.00148	.00059	.00043	.00126	.00282	.00036	.00096	.00077	.00098	.00055	.00196	.00047	.00256	.00133	1.06577											(22)
23) County roads	.01943	.02708	.01160	.01777	.00055	.00036	.00067	.00040	.00067	.00047	.00017	.00015	.00059	.00063	.00026	.00082	.00034	.00041	.04610	.00103	.02826	.00146	.00076	.02410	1.00062										(23)
24) Social services	.00059	.00067	.00065	.00034	.00075	.00042	.00054	.00041	.00118	.00094	.00022	.00020	.00073	.00084	.00016	.00044	.00040	.00041	.00025	.00087	.00021	.00114	.00104	.00122	1.00086									(24)
25) Administration	.00117	.00146	.00081	.00102	.00192	.00038	.00049	.00052	.00054	.00053	.00018	.00016	.00062	.00098	.00015	.00045	.00039	.00041	.00046	.00080	.00028	.00092	.00096	.00077	1.00166									(25)
26) City of Roseburg	.00377	.00477	.00528	.00336	.00500	.00372	.00481	.00331	.00676	.00504	.00181	.00141	.00842	.00587	.00113	.00342	.00459	.00306	.00174	.00546	.00151	.00683	.00649	.00746	.00400	.00615	.00471	1.00338	.00233						(26)
27) City of Sutherlin	.00091	.00113	.00114	.00063	.00120	.00080	.00099	.00069	.00246	.00159	.00058	.00039	.00143	.00132	.00026	.00073	.00087	.00075	.00044	.00136	.00037	.00174	.00180	.00189	.00099	.00118		1.00091							(27)
28) City of Myrtle Creek	.00098	.00114	.00117	.00061	.00124	.00082	.00100	.00085	.00310	.00158	.00064	.00038	.00141	.00151	.00022	.00080	.00093	.00075	.00044	.00113	.00030	.00144	.00145	.00156	.00099				1.00098						(28)
29) City of Reedsport	.00075	.00092	.00090	.00051	.00103	.00066	.00083	.00148	.00108	.00633	.00344	.00049	.00030	.00159	.00033	.00088	.00145	.00205	.00057	.00156	.00048	.00197	.00243	.00177						1.00140					(29)
30) Other incorporated cities	.00108	.00160	.00146	.00084	.00156	.00116	.00148	.00108	.00633	.00344	.00049	.00030	.00193	.00159	.00033	.00088	.00145	.00205	.00057	.76169	.17245	1.00693	.91192	.53305	.85417	.66758	.46728	.29850	.24969	.42840	.47744	1.31860	.29632		(30)
31) Households	.47833	.53360	.46469	.19349	.62857	.30402	.38306	.30655	.38405	.48689	.13091	.16554	.39067	.71314	.13464	.36291	.25055	.35517	.20822	.76169	.17245			.07161										1.00000	(31)
32) Visitors																																		(32)
Total	2.49352	3.09350	2.38560	1.54218	2.74858	2.63632	2.71810	1.86766	2.67875	2.42265	1.54333	1.42605	1.94016	2.71988	1.36878	2.15211	1.70244	1.85099	1.88324	2.98413	1.73237	3.26577	3.16666	3.53108	2.74369	3.17773	2.66808	2.15862	1.96538	1.85495	2.49268	2.32605	2.84806	2.84386

1/ For "backward linkages" only.

2/ Does not add up to 0.00001 due to rounding.

Table 4.--Final demand, by sector

Sector	Final demand	
	Dollars	Percent
1	19,416,284	5.4
2	40,510,209	11.3
3	124,930,481	34.8
4	39,800,000	11.1
5	0	--
6	3,118,251	.9
7	4,216,142	1.2
8	40,639,817	11.3
9	992,275	.3
10	22,753	(1/)
11	213,553	.1
12	2,675,617	.8
13	5,654,704	1.6
14	722,491	.2
15	2,814,981	.8
16	4,436,769	1.2
17	4,196,844	1.2
18	5,214,399	1.5
19	6,126,545	1.7
19a	8,658,788	2.4
20	1,880,770	.5
20a	1,530,840	.4
21	4,384,316	1.2
22	1,203,633	.3
23	2,476,969	.7
24	1,240,617	.3
25	1,536,502	.4
26	95,442	(1/)
27	297,165	.1
28	135,000	(1/)
29	250,482	.1
30	29,692	(1/)
31	10,333,988	2.9
32	18,851,170	5.3
Total	358,607,489	100.0

1/ Less than 0.1 percent.

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of timber processing industries in Douglas County even if the demand for the industries' forest products does not decline.

The multipliers in table 3 do not show the potential effect of this "forward" linkage from the resource industries to the processing industries. For example, the multiplier for the U.S. Forest Service sales sector (19) in table 3 is 1.9. This multiplier times the final demand of $6,126,545 for sector 19 indicates that $11,640,435 of the county's sales are directly and indirectly dependent on sector 19. Per dollar change in final demand, county sales would change by $1.90 including the dollar change in final demand. However, this tells us only the impact of a change in Forest Service exports and not the impact on the county of a change in Forest Service sales to firms in the county.

In order to evaluate the impact of a forward linkage, the structure of the sale and purchase patterns of one or more county industries must be altered. In our study, we evaluated the impact of backward linkages (changes in final demand) for sectors 1, 2, 3, 4, and Forest Service (19a) and Bureau of Land Management (20a) appropriated funds sectors. We also evaluated forward linkages (raw material constraints) for sectors 1, 2, 3, and 4 combined and for the Forest Service sales (19) and Bureau of Land Management sales (20). Our procedure for evaluating forward linkages is described in appendix B.

TIMBER DEPENDENCY
IN DOUGLAS COUNTY

Each of the other industries in Douglas County is more or less dependent on the forest-oriented sectors (1, 2, 3, 4, 19, 19a, 20, and 20a) according to linkages

in economic activity within the region. If we use as a measure of dependency the percentage of an industry's sales which are directly and indirectly dependent on the final demand for the eight forest-oriented sectors, timber dependency can be calculated with the information from the input-output model. Table 5 was derived by multiplying the column of direct and indirect multipliers from table 3 for each forest-oriented sector by the corresponding final demand for each forest-oriented sector and summing for the eight sectors.

Aside from the forest-oriented sectors, which are for the most part 100-percent dependent on sales outside the county, dependency ranges from 0 for the visitors sector (32) to 67.3 percent for the household sector (31).

The county economy as a whole is 68.7-percent dependent on the eight forest-oriented sectors. This finding contrasts with a study by Maki and Schweitzer (1973) which found that 98 percent of the export-based employment in Douglas County was timber-dependent in 1971. The difference in study findings can be attributed to differences in study methods and data bases. The Maki-Schweitzer study accepted the national percentage distribution of employment among industries as a norm. For the Douglas County economy, an industry with employment in excess of this norm was considered to be producing for export markets and therefore to be part of the economic base. The input-output study estimated directly the economic base of the county as measured by dollars of final demand and economic linkages in the county. Both studies show that timber and related industries account for the major portion of the export base for the Douglas County economy.

Table 5.--Sector dependency on forest-oriented sectors

Sector	Total sales	Percent dependent
	- - - Dollars - - -	
1	41,718,901	99.6
2	42,765,593	99.2
3	130,695,995	99.8
4	39,804,000	100
5	4,032,868	8
6	3,338,196	3.6
7	5,443,332	5.4
8	46,158,676	7.5
9	3,741,989	24.8
10	8,865,123	56.7
11	19,284,496	49
12	43,189,202	61.6
13	25,040,425	50.9
14	11,504,858	58.8
15	25,315,089	61.6
16	24,610,324	55.6
17	83,021,250	59.7
18	28,311,802	41.2
19	16,698,149	99.3
19a	8,658,788	100
20	16,854,785	99.6
20a	1,530,840	100
21	19,180,869	60.6
22	1,662,707	18.6
23	6,572,769	60.5
24	1,452,091	10
25	1,841,054	12.7
26	1,728,002	65.4
27	662,178	37.6
28	514,700	49.3
29	545,583	36.5
30	526,252	61.3
31	158,105,085	67.3
32	18,851,170	0
Total or average	842,227,141	68.7

THE IMPORTANCE OF LOCAL PURCHASES

An industry's impact on the local area will tend to be less to the extent that the industry does not purchase inputs from the local area. For example, the pulp, paper, and particleboard industry (4) sells almost all of its output to final demand, but 0.78 of each dollar spent goes for imports. Sector 4 thus has a relatively low output multiplier of 1.54 for each dollar of sales to final demand (table 3).

Local purchases generate interactions within the local economy while imports are "leakages" to the local economy. In terms of an industry's importance to a local economy, these leakages will be offset to the extent that the industry has a high volume of sales or purchases input from sectors that have high multipliers.

The information developed in this

section of the report will be used to discuss the impacts of changes in demand and changes in timber availability for the forest-oriented sectors in the Douglas County model.

U.S. FOREST SERVICE AND BUREAU OF LAND MANAGEMENT SALES AND EXPENDITURES PATTERNS

The Forest Service and Bureau of Land Management sales and expenditures patterns have some unique characteristics which differ from privately owned operations. The purpose of this section is to describe these patterns in order to provide background information for subsequent discussions of the impact of changes in demand and resource availability for these two agencies.

Timber management activities carried on by the Bureau of Land Management and the U.S. Forest Service differ from forest industry's in the sense that there is no direct link between timber sales and management activity; funds are appropriated for management independent of timber sales levels. While there is a link between sales and appropriations in the sense that sales preparation depends on appropriated funds, expenditures from the sales sectors (19 and 20) and appropriated funds sectors (19a and 20a) were separated in our analysis. The input-output model assumes for each industry that payments by each sector to all other sectors remain a constant proportion of the sales dollar. If we had aggregated the sales and appropriated funds sectors, anomalies such as an increase in appropriated funds increasing payments to counties and an increase in sales increasing timber management activities would have occurred. More realistically, an increase in sales is necessary to increase payments to counties, and an increase in

appropriated funds is necessary to increase forest management expenditures.

SALES SECTORS

Rows 19 and 20 in table 1 show the pattern of sales for the sales sectors of the U.S. Forest Service and Bureau of Land Management, respectively. For both agencies, almost all of the sales were to firms in sectors 1, 2, and 3 within Douglas County and to firms which were located outside the county but purchased timber from the two agencies in the county. The latter sales show as exports.

Columns 19 and 20 in table 1 show the pattern of expenditures for the sales sectors of the U.S. Forest Service and Bureau of Land Management, respectively. For both agencies, expenditures were limited to sectors 1, 2, 3, and imports (33) for purchaser-built roads; sectors 21 and 23 for schools and roads; and State and Federal Government (34).

The Forest Service and Bureau of Land Management pay for purchaser-built roads through stumpage allowances. In other words, the purchaser pays for the timber as if the roads were in place and, by reducing the cost of the timber to the purchaser, the Forest Service or Bureau of Land Management pays the purchaser for building the roads. Although no money actually changes hands for purchaser-built roads, in terms of values created and economic activity generated, the purchaser pays the Forest Service or BLM and the agency in turn reimburses the purchaser. In our study, the value of the purchaser-built roads shows as an expenditure for the purchaser (a receipt for the agency) and as an expenditure for the agency (a receipt for the purchaser). It was necessary to show purchaser-built roads in this manner to show the link between timber sales and road construction.

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Total payments to sectors 21 and 23 are set by payment formulas for each agency. For each Forest, 25 percent of the total receipts of the Forest are earmarked for payments to counties. These receipts do not include the value of purchaser-built roads and funds collected to improve the timber sale area after harvest. Each county then receives the proportion of this fund corresponding to the acreage of the Forest in the county. In our study, only payments from the Umpqua National Forest and the Smith River District of the Siuslaw National Forest were attributed to the Forest Service in Douglas County. Payments to Douglas County from adjacent National Forests which have land in Douglas County are included as payments to the county from the State and Federal Government sector.

The Bureau of Land Management lands in Douglas County are "O&C" lands. These lands were revested by the Federal Government from the Oregon and California Railroad Company in the early 1900's. In 1970, counties received 50 percent of the receipts from O&C lands in the State of Oregon. Since the 1950's, they have forgone 25 percent of O&C receipts which are used to manage O&C lands. The O&C receipts used as a basis for payment do not include the value of purchaser-built roads. Payments are distributed to counties on a proportional basis according to the assessed value of O&C lands in each county in 1915. Douglas County receives approximately 25 percent of the O&C payments to counties each year. Since the counties receive 50 percent of O&C revenues, this means that Douglas County receives 12.5 percent of total O&C receipts generated in the State. Therefore, only 12.5 percent of the receipts generated on O&C lands managed by the Roseburg District was attributed to the Bureau of Land Management in Douglas County. Payments from all other

Districts to Douglas County were included as a payment from the State and Federal Government (34) to the county for schools and roads.

The Umpqua National Forest manages some O&C lands intermingled with National Forest lands. Douglas County receives payments from these lands according to the O&C payment formula. Payments to Douglas County from these "controverted" lands managed by the Forest Service were attributed to the Forest Service rather than the Bureau of Land Management.

Total payments to Douglas County from the Forest Service and the Bureau of Land Management were allocated to sectors 21 and 23 on the basis of the proportion of county expenditures for these two purposes in 1970.

All receipts collected by the Forest Service or Bureau of Land Management are paid directly to the general fund of the U.S. Treasury. These payments include funds earmarked for counties. Although Douglas County receives payment from the Treasury rather than the Forest Service or Bureau of Land Management, we show payments coming from the agencies to the county. We did this because the payments are based on a fixed formula and we wanted to show the direct link between agency sales and payments to counties. In columns 19 and 20, all receipts excluding payments to counties and for purchaser-built roads are shown as going to the State and Federal Government sector.

APPROPRIATED FUNDS
SECTORS

Rows 19a and 20a show the source of money for the appropriated funds sectors of the U.S. Forest Service and the Bureau of Land Management, respectively. All

of the money spent by these two agencies comes directly from the State and Federal Government (34). In the input-output format, this appears as a sale to sector 34.

Columns 19a and 20a of table 1 show how these appropriated funds are spent by the two agencies. For the U.S. Forest Service (19a), expenditures are concentrated in the construction (16), household (31), and imports (33) sectors. For the Bureau of Land Management (20a), expenditures are concentrated in the household (31) and imports (33) sectors.

IMPACTS OF CHANGES IN DEMAND

TIMBER PROCESSING
INDUSTRIES

In order to show the economic impact of a change in final demand in the timber processing industries (1, 2, 3, 4), a $100,000 change in final demand was assumed for each of the sectors independently. The input-output model assumes that impacts are proportional. For example, this means that a $200,000 change in demand would have twice the impact of a $100,000 change in demand. A change in sales value of final demand could occur because of a change in product price, a possibility in the price-volatile lumber and plywood industries, or because of a change in the sale of product.

If prices do change, the input-output model would treat the change in sales to final demand as a change in the amount of product produced. The model would then not show a completely realistic picture of the impacts of price changes. The price changes would cause changes in the pattern of sales and expenditures for firms and agencies which buy and sell stumpage, and this would not be reflected in the model. We recognize this as a

drawback in the model but do not feel that it mitigates the value of the input-output approach in identifying sectors affected by the forest-oriented sectors in Douglas County. Prices can change daily in the lumber and plywood industries, and over time, the prices used in the model should reflect a reasonable estimate of the impacts of these industries resulting from changes in actual volume output.

Table 6 shows that, for each of the timber processing sectors, households (31) receives the most impact of any sector from a change in final demand for the processing industries. This change in payments to households (31) is about $50,000 for sectors 1, 2, and 3, but only $20,000 for sector 4. Most of the change in payments to sector 31 are salary payments. The pulp and board industry (4) is relatively capital intensive compared with sectors 1, 2, and 3; therefore, salary payments for sector 4 make up a smaller proportion of expenditures.

Other sectors which are relatively more affected by sector 1 include automotive sales and service (12) and retail and wholesale trade (17). Per dollar of change in final demand, sector 2 has relatively more impact on timber harvesting and hauling (1), sectors 12, 15, and 17, and the Bureau of Land Management (20). Sectors 3 and 4 are more important for sectors 12 and 17 than for other industries in the county.

IMPACT OF A CHANGE IN
APPROPRIATED FUNDS FOR THE
U.S. FOREST SERVICE AND
BUREAU OF LAND MANAGEMENT

With the exception of purchaser-built roads, Forest Service and Bureau of Land Management expenditures are based on appropriated funds. The level of these funds in Douglas County is determined by

Table 6.--Dollar change in internal sectors' sales per $100,000
change in demand for each timber processing sector

Internal sector	Timber processing sector			
	1	2	3	4
	- - - - - - - - *Dollars* - - - - - - - -			
1	102,854	34,525	5,452	891
2	444	101,134	649	646
3	1,033	2,635	102,542	116
4	0	0	0	100,000
5	275	185	113	51
6	54	62	52	23
7	129	242	104	45
8	3,214	2,075	1,215	554
9	418	465	403	169
10	2,261	2,523	2,196	916
11	6,289	5,356	3,670	1,509
12	19,981	15,608	10,124	4,149
13	8,038	7,805	4,895	2,274
14	3,344	3,440	2,805	1,234
15	7,325	17,489	4,736	1,351
16	3,829	4,794	6,014	2,756
17	22,218	27,052	20,686	10,653
18	6,110	6,229	4,850	2,106
19	1,148	4,414	6,695	48
19a	0	0	0	0
20	5,879	10,710	7,405	138
20a	0	0	0	0
21	3,686	5,212	5,051	2,656
22	125	158	133	73
23	1,943	2,708	1,160	1,777
24	59	67	65	34
25	117	146	81	102
26	377	477	528	336
27	91	113	114	63
28	98	114	117	61
29	75	92	90	51
30	108	160	146	84
31	47,833	53,360	46,469	19,349
32	0	0	0	0
Total	249,352	309,350	238,560	154,218

national and agency priorities. Changes in appropriated funds could be applied to existing programs or used to initiate new programs.

Table 7 shows the impact of a $100,000 change in U.S. Forest Service appropriations and a similar change for Bureau of Land Management appropriations. Changes were made independently for the two agencies. For the Forest Service, this amounts to a 1.2-percent change in appropriations and for the Bureau of Land Management, 6.5 percent. The input-output model assumes that each agency would increase or decrease expenditures proportionately according to the corresponding spending patterns of columns 19a and 20a in table 2.

All of the change in appropriated funds is interpreted in our model as a change in final demand for sector 19a or sector 20a. The direct and indirect effect of a $100,000 change in final demand is derived by multiplying the coefficients in column 19a or 20a of table 3 by $100,000.

For both agencies, the sector most affected by a change in appropriated funds is 31, households. This is because most of the appropriated funds are spent for salary payments. Because the expenditure pattern is not the same for both agencies, other sectors in the economy are affected differently by each agency. For example, sales of retail and wholesale trade (17) change by $33,778 per $100,000 for the Forest Service and $39,869 for the Bureau of Land Management. This difference is due in part to the fact that a higher proportion of the BLM's appropriated funds is spent for household payments. Through their expenditure patterns in the county, households have a high multiplier effect in other sectors.

In total, county sales would change

by $298,413 per $100,000 for the Forest Service, and $326,579 per $100,000 for the Bureau of Land Management. These totals include the initial $100,000 change for each agency.

Up to this point, we have assumed that resources in the county are present to absorb an increase in sales for any one sector. This was done to demonstrate the impact of changes in demand for the forest-oriented sectors. The next section addresses the question of what might happen if the supply of timber is reduced in Douglas County.

IMPACT OF CHANGES IN TIMBER AVAILABILITY IN DOUGLAS COUNTY

USING THE INPUT-OUTPUT MODEL TO DERIVE THE LOCAL IMPACT OF TIMBER AVAILABILITY

In the following analyses, we show the impact of changes in timber availability from private lands, the Forest Service, and Bureau of Land Management. We derived the impact of timber availability in three situations.

First, we reduced timber harvest on private lands and held industry purchases from the Forest Service and Bureau of Land Management constant. Second, we reduced industry purchases from the Forest Service and Bureau of Land Management and kept industry purchases from private lands constant. In these two situations, we assumed that the effects of declines in timber availability would not be mitigated by increased imports from other areas or increased harvest on other ownerships. If the present situation continues, this is a reasonable assumption because of the projected general decline in timber

*Table 7 --Dollar change in internal sectors' sales per $100,000 change
in appropriated funds for the U.S. Forest Service
and Bureau of Land Management*

Internal sector	U.S. Forest Service	Bureau of Land Management
	- - - - - - - - - - *Dollars* - - - - - - - - - -	
1	1,827	3,595
2	392	271
3	583	666
4	0	0
5	202	213
6	85	109
7	170	213
8	2,209	2,263
9	683	870
10	3,598	4,770
11	7,031	8,452
12	16,411	20,714
13	7,787	8,904
14	6,151	5,987
15	4,656	5,674
16	23,013	5,793
17	33,778	39,869
18	8,128	10,254
19	10	125
19a	100,000	0
20	184	278
20a	0	100,000
21	3,792	4,886
22	196	256
23	103	146
24	87	114
25	80	92
26	546	683
27	136	174
28	137	174
29	113	144
30	156	197
31	76,169	100,693
32	0	0
Total	298,413	326,579

harvest in southwestern Oregon. In the third situation, we assumed that declines in private timber harvest would be offset by increases in timber harvests from the Forest Service and Bureau of Land Management in Douglas County.

Changes in resource availability in a local area will change the sales or expenditures pattern for one or more sectors in the model. A problem with using the input-output model in this manner is to anticipate how the sales and expenditures patterns will change. Appendix B explains our rationale for changing sales and expenditures patterns for the affected sectors.

In our analysis, the impact of a change in timber harvest is proportional to the change in timber harvest. For example, a 50-percent reduction in private timber harvest will have twice the impact of a 25-percent reduction. For marginal changes, the proportionality assumption is reasonable. For major shifts in timber availability, changes in the economic structure of the county can be expected to occur. For example, as timber becomes less available, industry might more intensively utilize timber and this in turn could further alter purchase and expenditure patterns for the timber processing industry. For these reasons, economic impacts derived from changes in resource availability should be viewed as approximations.

Although available projections for timber availability in the Douglas County area show declining availability on private lands, the timing of declines in timber harvest will depend on the actions of firms and agencies which affect timber harvest in Douglas County. Any change in timber harvest patterns will most likely occur over a number of years. We can use the input-output model to project economic impacts for changes in timber harvest

levels, but the resulting information should be used with the realization that our data base for economic interactions is for 1970. By the time timber harvest levels change as projected, economic interactions in the county may change. For this reason also, projections of economic impact based on changes in resource availability should be viewed as approximations.

IMPACT OF CHANGES
IN PRIVATE TIMBER
HARVESTS

According to Hamill's (1963) projections, a 50-percent decline in private timber harvest can be expected over the next 10 to 20 years. In our analysis, a 50-percent decline in private timber harvest would mean an 18.9-percent decline in timber availability for the timber processing industries. Although the private harvest is about 50 percent of the total, the reduction in timber to Douglas County industries is less than 25 percent. This is because in our model a higher proportion of the harvest from private land is exported from the county than is the case for harvest from Federal agencies' lands. (See appendix B for more detail on procedure.)

We do not have sufficient information to estimate the timber harvest decline by ownership within the private sectors, nor do we know which of the timber processing industries will be faced with reduced timber supplies. Because of this, we combined the timber-processing sectors (1, 2, 3, and 4) into one industry, the timber processing industry (1-4).

If timber harvest on private lands declines by 50 percent, then total gross output of the timber processing industry should decline by 18.9 percent because 18.9-percent-less timber would be available to the industry. Sales of timber from the Forest Service and Bureau of Land

Management to the timber processing industry were held constant as were timber imports.

Table 8 shows the impact on sales of other sectors in the county of a 50-percent reduction in private timber harvest. In terms of the percentage of each sector's sales, the impact ranges from 0 for the Forest Service appropriated funds sector (19a), both of the Bureau of Land Management sectors (20 and 20a), and the visitors sector

Table 8.--Decline in internal sectors' sales caused by a 50-percent reduction in private timber harvest

Internal sector	Total sales before harvest reduction	Decline in sales
	- - - - Dollars - - - -	*- Percent -*
1-4	254,984,662	18.90
5	4,032,531	1.32
6	3,338,661	.63
7	5,442,594	.95
8	46,158,717	1.30
9	3,740,987	4.17
10	8,864,702	9.58
11	19,284,315	8.28
12	43,188,757	10.57
13	25,039,864	8.73
14	11,503,773	9.75
15	25,313,835	11.19
16	24,609,753	11.16
17	83,020,350	10.16
18	28,313,372	6.94
19	16,697,255	.04
19a	8,658,788	0
20	16,854,082	0
20a	1,530,840	0
21	19,180,162	7.60
22	1,664,172	3.26
23	6,572,041	8.13
24	1,451,987	1.73
25	1,841,232	2.32
26	1,728,806	11.55
27	661,853	6.64
28	515,071	8.70
29	544,734	6.09
30	525,676	10.54
31	158,104,552	11.36
32	18,851,170	0
Total or average	842,219,295	11.30

(32) to 11.55 percent for the City of Roseburg (26). Payments to households (31) would decline by 11.36 percent. Total sales in the county would decline by 11.3 percent.

In terms of dollars of sales, payment to households (31) would decline by the largest amount of any sector except the timber processing industry: $18 million. The input-output model used here is not designed to estimate employment impacts. However, we can place the impact on employment in perspective if we assume that all payments to households are salaries. A salary total of $18 million would amount to 1,800 jobs paying $10,000 per year.

Sales of the timber processing industries (1-4) would decline by $48.2 million. Payments for education (21) and county roads (23) would decline a total of $2 million.

Final demand for each of the internal sectors remained constant with the exception of the timber processing industry (1-4) which had a $42.7 million decline in final demand to $182 million.

Because the economic impact of changes in timber harvest is proportional to changes in harvest, we can estimate the change in sales attributable to a given percentage change in harvest. For example, a 1-percent decrease in private timber harvest would reduce county sales by 2 percent of the amount caused by a 50-percent reduction in private harvest or 0.23 percent.

The impact caused by changes in private timber harvest on the county economy is equal for equal increases or decreases in private harvest. For example, a 1-percent increase in private harvest would increase county sales by 0.23 percent.

IMPACTS OF CHANGES IN TIMBER HARVEST ON FOREST SERVICE AND BUREAU OF LAND MANAGEMENT LANDS

The Forest Service and Bureau of Land Management each account for about 25 percent of the total timber harvest in Douglas County. We used the input-output model to estimate the impact on the county economy if timber harvest for either of these two agencies declined by 10 million board feet while private harvest and timber imports remained constant. The level of timber sales for both agencies is subject to review and may be either increased or decreased consistent with agency objectives and funding. For example, sales may be reduced because of changes in land use classification or reductions in funding for timber sales preparation. Since the input-output model is based on dollars of sales and expenditures, changes in timber sales volume were converted to changes in dollars of sales.

We converted 10 million board feet of timber sales to $495,500 for the Forest Service and to $495,700 for the Bureau of Land Management. Average prices were $49.55 per thousand board feet for the Forest Service and $49.57 for the Bureau of Land Management. These prices approximate average 1970 prices on the Umpqua National Forest and the Roseburg District, respectively, and include allowances for purchaser-built roads (see appendix B for discussion of allocation of volume to the processing sectors (1-4) and to exports).

We did not include any allowance for changes in appropriated funds commensurate with changes in timber sales volume. For marginal changes in volume such as 10 million board feet, this is a

reasonable assumption. Management priorities can be shifted in the short run to achieve marginal changes in sales volume. For larger changes, such as 25 or 50 percent, an increase in appropriated funds is a more reasonable assumption.

Table 9 shows the reduction in each internal sector's sales associated with a 10 million-board-foot reduction in timber sales for either the Forest Service or Bureau of Land Management.

In terms of the percentage of

Table 9.--Decline in internal sectors' sales caused by a 10 million-board-foot change in Forest Service or Bureau of Land Management timber sales

| Internal sector | Total sales before harvest reduction | Decline in sales | |
		Forest Service	Bureau of Land Management
	- - - *Dollars* - - -	- - - - - - *Percent* - - - - - -	
1-4	254,984,662	0.59	0.84
5	4,032,531	.04	.06
6	3,338,661	.02	.02
7	5,442,594	.03	.04
8	46,158,717	.04	.05
9	3,740,987	.14	.19
10	8,864,702	.32	.43
11	19,284,315	.27	.37
12	43,188,757	.36	.48
13	25,039,864	.30	.39
14	11,503,773	.33	.44
15	25,313,835	.36	.50
16	24,609,753	.31	.40
17	83,020,350	.35	.47
18	28,313,372	.25	.32
19	16,697,255	2.95	.01
19a	8,658,788	0	0
20	16,854,082	0	2.93
20a	1,530,840	0	0
21	19,180,162	.57	.53
22	1,664,172	.10	.14
23	6,572,041	.55	.52
24	1,451,987	.05	.07
25	1,841,232	.07	.10
26	1,728,806	.38	.51
27	661,853	.21	.29
28	515,071	.28	.38
29	544,734	.21	.28
30	525,676	.35	.48
31	158,104,552	.39	.52
32	18,851,170	0	0
Total or average	842,219,295	0.44	0.58

internal sectors' sales, the impact for the Forest Service ranges from 0 for the Forest Service appropriated funds sector (19a), both of the Bureau of Land Management sectors (20 and 20a), and the visitors sector (32) to 0.59 percent for the timber processing industry (1-4). Payments to Douglas County for schools (21) and roads (23) would decline 0.57 percent and 0.55 percent, respectively. Payments to households would decline 0.39 percent. Total county sales would decline 0.44 percent.

Total gross output of the timber processing industry (1-4) would decline by $1.5 million. Payments to households (31) would decline by $616,608.

Final demand for each sector remained constant, with the exceptions of the timber processing industry (1-4) which had a decline in final demand of $1.3 million to $223.3 million and the Forest Service sales sector (19) which had a decline of $181,797 to $5.9 million.

In terms of the percentage of internal sectors' sales, the impact for the Bureau of Land Management ranges from 0 for the Forest Service (19a) and Bureau of Land Management (20a) appropriated funds sectors and the visitors sector (32) to 0.84 percent for the timber processing industry (1-4). Payments to Douglas County for schools (21) and roads (23) decline 0.53 and 0.52 percent, respectively. Household receipts decline 0.52 percent and total county sales, 0.58 percent. A 10 million-board-foot reduction in Bureau of Land Management sales volume would reduce agency receipts by 2.93 percent.

Final demand for each sector remained constant, with the exceptions of the timber processing industry (1-4) which had a $1.9 million decline to

$222.8 million and the Bureau of Land Management sales sector (20) which had a decline of $55,313 to $1.8 million.

In our analysis, economic impacts are proportional to changes in timber sales volume. For example, a 1 million-board-foot decline in volume would have 10 percent of the impact of a 10 million-board-foot decline. Thus, a 1 million-board-foot decline in Forest Service timber sales would cause county sales to decline 0.04 percent and for the Bureau of Land Management, 0.06 percent.

"FORWARD-LINKED" MULTIPLIERS VS. "BACKWARD-LINKED" MULTIPLIERS FOR THE FOREST SERVICE AND BUREAU OF LAND MANAGEMENT

We have used the input-output model to identify the impact of both forward and backward linkages for the Forest Service and Bureau of Land Management. Per dollar of change in timber sales, these linkages lead to different impacts on the local economy. The sum of the coefficients in column 19 of table 3 shows that per dollar of change in final demand for the Forest Service, county sales change by $1.88 and for the Bureau of Land Management in column 20, $1.79. These "backward-linked" multipliers show the total direct and indirect impact on the Douglas County economy of a $1 change in agency exports.

"Forward-linked" multipliers can be derived for the two agencies from table 9. For the Forest Service, a $492,837 change in timber sales caused county sales to change by $3,711,507 for a multiplier of 7.53. For the Bureau of Land Management, a $493,231 change in timber sales caused county sales to

change by \$4, 839, 753 for a multiplier of 9.81.

Both agencies consider local economic impact when evaluating changes in administrative policies. The forward- and backward-linked multipliers tend to form two extremes for the local economic impact of agency actions and the impact realized by the economy would tend to lie between these two extremes.

The forward-linked multiplier measures the local economic impact if the effect of a change in timber sales volume is not offset by compensating changes in timber volume from other ownerships. For example, if the Forest Service reduced timber sales volume by 10 million board feet and private landowners were able to increase harvest by enough to offset this reduction, the impact on the county economy would be less than in a situation where private landowners could not increase timber harvest.

Because the backward-linked multiplier measures the local economic impact of changes in timber exports, the multiplier attributes to stumpage, at most, the direct and indirect value of harvesting and transporting the timber outside the county. The forward-linked multiplier attributes to stumpage the direct and indirect values of harvesting, transporting, and processing the timber in the county. In other words, the forward-linked multiplier assumes that the timber will be further processed than does the backward-linked multiplier.

In view of the projected decline in timber availability in Douglas County, the forward-linked multiplier is the more reasonable estimate of the local economic impact of declines in timber harvest on Forest Service and Bureau of Land Management lands. Declines in timber harvest on lands administered by these two agencies cannot be continuously offset by increases in private harvest nor by imports.

EFFECT OF A DECLINE
IN PRIVATE HARVEST
AND COMPENSATING
INCREASE IN PUBLIC
HARVEST

In the preceding two sections, we have shown the effect of independent changes in timber harvest from private, Forest Service, and Bureau of Land Management lands. In this section, we show the effect on the local county economy if declines in private timber harvest are offset by compensating increases in public timber sales volume. Newport (1972) has suggested that combining harvest schedules of private and public land in Douglas County might prove to be complementary for total harvest. In our analysis, we do not attempt to estimate the total harvest which might result from such a combination.

We used the input-output model to show the effect on the Douglas County economy if a private harvest decline of 50 percent is offset by an increase in harvest from the Forest Service (19) and Bureau of Land Management (20) sufficient to maintain log consumption by the timber processing industry (1-4). A 50-percent decline in private harvest would require a 39.1-percent increase in harvest on the two Federal agencies' lands (see appendix B for discussion of procedure for allocating harvest to exports). Therefore, we assumed that timber harvest would increase by 39.1 percent for both agencies. Increases in appropriated funds would be necessary for a change in sales of this magnitude. Accordingly, we increased appropriated funds by 39.1 percent for both agencies

and assumed that total appropriations would be spent proportionately according to columns 19a and 20a of table 2. For such an unprecedented shift in public policy in Douglas County, county economic structure and/or agency spending patterns might change from previous patterns. Therefore, our estimates of economic impact should be viewed as approximations.

Table 10 shows that the change in policy results in sales increases for each internal sector with the exceptions of the timber processing industry (1-4) and the visitors sector (32) which had no change in sales. For the county economy as a whole, sales would increase 3.6 percent. An increase in county sales indicates that the spending and sales patterns for

Table 10.--Net increase in internal sectors' sales resulting from a decrease in private harvest offset by harvest increases on Forest Service and Bureau of Land Management lands

Internal sector	Total sales before harvest change	Increase in sales
	- - - Dollars - - -	- - Percent - -
1-4	254,984,662	0
5	4,032,531	.28
6	3,338,661	.12
7	5,442,594	.19
8	46,158,717	.27
9	3,740,987	1.11
10	8,864,702	2.44
11	19,284,315	2.07
12	43,188,757	2.28
13	25,039,864	1.88
14	11,503,773	2.85
15	25,313,835	1.04
16	24,609,753	4.63
17	83,020,350	2.40
18	28,313,372	1.79
19	16,697,255	38.90
19a	8,658,788	39.10
20	16,854,082	39.10
20a	1,530,840	39.10
21	19,180,162	8.04
22	1,664,172	.70
23	6,572,041	6.91
24	1,451,987	.29
25	1,841,232	.21
26	1,728,806	1.93
27	661,853	1.34
28	515,071	1.29
29	544,734	1.42
30	525,676	1.90
31	158,104,552	2.88
32	18,851,170	0
Total or average	842,219,295	3.59

the two agencies differ from the timber processing sectors (1-4). With this change in policy, payments to the county for education (21) would increase 8 percent and for county roads (23), 6.9 percent. Payments to households (31) would increase by 2.9 percent. Because we assumed that the harvest increase on the two agencies' lands offsets the decline in private harvest, the output of the timber processing industry does not change.

Only the final demand for sectors 19, 19a, 20, and 20a changed in our example. This was done to reflect the increase in appropriated funds (19a and 20a) and the maintenance of exports as constant proportions of Forest Service (19) and Bureau of Land Management (20) timber sales. After the change in policy, final demands for the appropriated funds sectors were $12 million for the Forest Service (19a) and $2.1 million for the Bureau of Land Management (20a). Final demands for the sales sectors were $8.5 million for the Forest Service (19) and $2.6 million for the Bureau of Land Management.

We estimated the impact of a change in policy according to the change in county sales. Many other factors would undoubtedly have to be considered in evaluating the desirability of such a change in Federal forest management policy.

SUMMARY

IMPACTS IDENTIFIED
IN THIS REPORT

This study has shown, through the input-output technique, that approximately two-thirds of the economic base of Douglas County is dependent on the actions of the area's timber processing industries and the U.S. Forest Service and the Bureau of Land Management. Available projections of future timber supply for the Douglas County area indicate that timber harvest from private lands will decline substantially over the next 10 to 20 years because of reductions in inventory on these lands. Information to identify those industries which will be affected by changes in timber-oriented sectors is necessary to plan adjustments or to take actions to offset projected changes.

The input-output model of the Douglas County economy can be used to evaluate a broad range of timber supply alternatives for the area. However, a set of assumptions is necessary to evaluate each alternative, and the implications for each alternative should be interpreted within the framework established by the assumptions. The model can also be used to evaluate alternative sets of assumptions. Changes in timber supply occur over time and may cause changes in the county economic structure depicted in the input-output model. For these reasons, the consequences of alternative timber supply situations evaluated within the input-output framework should be viewed as approximations.

We have shown the potential impacts for independent $100,000 changes in demand for the four timber processing industries in the Douglas County model: Timber harvesting and hauling, sawmills, plywood and veneer mills, and pulp, paper, and particleboard plants. The potential impacts of independent $100,000 changes in appropriated funds for the Forest Service and Bureau of Land Management were also identified. We identified the impacts of changes in timber supply for the following situations.
1. Independent 10 million-board-foot reductions in timber harvest from the Forest Service and Bureau of Land Management.

2. A 50-percent reduction in private timber harvest with harvest from other timber supply sources held constant.

3. A 50-percent reduction in private timber harvest which is offset by increased harvest from Forest Service and Bureau of Land Management lands.

Within the framework of the model, the impacts of changes in demand and timber supply are proportional. For example, a $50,000 change in demand will have one-half the impact of a $100,000 change and a 5 million-board-foot change in harvest will have one-half of the impact of a 10 million-board-foot change.

CONCLUSIONS

USE OF THE REPORT FOR COUNTY PLANNING

If private timber harvest in Douglas County declines by 50 percent over the next 10 to 20 years as has been projected, our study indicates that total county sales will decline by 11.3 percent and payments to households will decline by 11.4 percent. In this situation, output of the timber processing industry would decline 18.9 percent and other sectors' sales or gross receipts would decline by up to 11.5 percent.

From a county planning standpoint, the projected impacts of a decline in private timber harvest can be accepted or steps initiated to offset the projected impacts. Alternatives open to county or regional planning organizations depend on the opportunities in Douglas County and the resources available to the organizations. The input-output model can be used to evaluate alternatives as means to offset the projected consequences of a declining private timber harvest. Data

needed for each alternative include expenditure and receipt patterns according to the county industries in the model.

Although the forest resource is renewable, little can be done to increase timber volume for harvest from private lands in Douglas County during the next 10 to 20 years. Forest management activities initiated now will require from 50 to 100 years to be reflected in increased timber harvest in the county.

Within the forestry sector, increased forest management activities and more intensive utilization of the timber resource offer potential for offsetting at least some of the employment consequences of a reduced private timber harvest. With appropriate data, the input-output model would be of use in evaluating alternative management and utilization programs.

Increased Forest Service and Bureau of Land Management timber harvest in Douglas County is a potential way to offset a short-run harvest decline on private lands. Our study identifies the Douglas County industries which would be affected by this change in policy. The feasibility of this shift in agency policy would depend in part on agency objectives and the objectives of private landowners in Douglas County.

Development of nontimber-dependent industries is another alternative which has potential for offsetting the projected consequences of a declining private timber harvest. The Douglas County input-output model can be used to evaluate new industries for Douglas County. The necessary information is the expenditure and sales patterns for each proposed industry in terms of the county industries defined in this report. The potential of new industries for Douglas County will depend on the locational and resource advantages

in Douglas County as compared with other competing areas. When these industries have been identified and the necessary information collected, a new column and a new row can be added to the input-output model and the resulting economic flows evaluated for their value in offsetting declines in the timber-dependent industries. Evaluation of new industries should include a consideration of the industries' local purchase and sales patterns and the total sales of the industries. A study by Gudger and Smith (1972) offers potential for identifying promising industries.

USE OF THE REPORT
BY THE U.S. FOREST
SERVICE AND THE
BUREAU OF LAND
MANAGEMENT

Community stability is one of the objectives considered by the Forest Service and Bureau of Land Management in planning forest-land management.

Information in this report provides the two agencies with a means to identify the industries and agencies in the county which will feel the impact of changes in appropriations and timber sales. When the timber processing industry output is constrained by timber supply, a forward-linked multiplier measures the impact on the local economy of changes in timber availability. Our study shows that the forward-linked multiplier for the Forest Service in Douglas County is 7.5 and for the Bureau of Land Management, 9.8. In other words, per dollar of change in timber sales for the Forest Service, total sales in the county change by $7.50 and for the Bureau of Land Management, $9.80.

The input-output model can be used to test other agency policy changes. For each proposed policy, data are needed for agency sales and expenditure patterns by county sector. Other sectors' sales and expenditures before and after the policy change can then be compared to evaluate economic impacts.

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APPENDIX A. Type of Business or Organization in Each Sector [1]

Sector number	Sector	Business types
1	Timber harvesting and hauling	Logging and log hauling operations.
2	Sawmills	Largest portion of sales come from sale of sawmill lumber and products.
3	Plywood and veneer mills	Largest portion of sales from plywood and veneer products.
4	Pulp, paper, particleboard plants	Largest portion of sales from pulp, paper, or particleboard products.
5	Commercial fishing	Trollers, trawlers, gill netters, and commercial clammers and crabbers.
6	Horticulture	Farms that receive the largest portion of their gross sales from the sale of crops.
7	Livestock	Ranches that receive the largest portion of their sales from the sale of livestock.
8	Manufacturing	Food processors (including seafoods, creameries, ice cream, bakers, meat and poultry), soft drink bottling companies, machine manufacturing, stone and clay processors, glass products, box products, canvas products, bioproducts, foundries, and mining.
9	Lodging	Hotels, motels, trailer parks, apartments, boarding houses, rooming houses.
10	Cafes and taverns	Restaurants, cafes, taverns, drive-ins, short-order eating places, and ice cream parlors.
11	Service stations	All service stations and wholesale gasoline distributors.
12	Automotive sales and service	New and used auto and trailer sales, tire stores, parts and accessories, auto repair shops, towing, automotive body and paint shops, auto upholstery, boat dealers, trailer towing, tire recapping, and farm implement dealers.

[1] Source: Youmans et al. (1973).

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Sector number	Sector	Business types
13	Communications and transportation	Trucking, railroads, airlines, buses, radio and television stations, telephone company, telegraphy, newspapers, television cable company, taxicabs, auto leasing, moving vans, trailer rentals, tugs, and barge service.
14	Professional services	Hospitals, doctors, dentists, lawyers, accountants, bookkeepers, chiropractors, architects, surveyors, engineers, medical and dental laboratories, optometrists, funeral homes, veterinarians, ambulance service, nursing homes, and appraisers.
15	Financial services	Banks, savings and loan associations, stockbrokers, financial companies, and credit bureaus.
16	Construction	Firms that contract for building, electrical, plumbing, road and highway, painting, heating, roofing, flooring, shipbuilders, sand and gravel operations, carpenters, asphalt paving companies, concrete manufacturers, excavators, land levelers, masonries, well drillers, cabinet makers, tile layers, sheet metal firms, plasterers, electrical and hardware stores, steel and pipe dealers, retail lumber yards, salvage companies, and commercial refrigeration contractors.
17	Retail and wholesale trade	Natural gas companies, fuel oil dealers, electric utilities, bottled gas suppliers, clothing stores, shoe stores, department stores, variety stores, furniture and appliance stores, jewelry stores, beer distributors, drugstores, office supply stores, milliners, State-owned liquor stores, music stores, flower shops, camera shops, paint stores, newsstands, gift shops, fisherman's supply stores, printing companies, cold storage and ice dealers, wholesale-retail groceries and supermarkets, and all wholesale dealers supplying the above stores if located in Douglas County.

Sector number	Sector	Business types
18	Retail services and organizations	Privately owned kindergartens and child nurseries, photo studios, theaters, bowling lanes and other recreational facilities, laundries and cleaners, tailors, barbers and beauty shops, upholstery, machine and welding shops, car washes, private business schools, music teachers, repair shops, unions, lodges, service organizations, building rental services, garbage collectors, insurance and real estate, churches, vending machine operators, private parking lots, trading stamp companies, private employment agencies, janitorial service, credit services, telephone answering service, and security police.
19	U.S. Forest Service	Transactions of the U.S. Forest Service conducted in Douglas County from funds generated by stumpage or user-fees.
19a	U.S. Forest Service appropriations	Transactions of the U.S. Forest Service conducted in Douglas County from Federal appropriations.
20	Bureau of Land Management	Transactions of the Bureau of Land Management conducted in Douglas County from funds generated by stumpage or user-fees.
20a	Bureau of Land Management appropriations	Transactions of the Bureau of Land Management conducted in Douglas County from Federal appropriations.
21	Education	Includes all school districts in the county, Intermediate Education District (IED), the community college, and the county superintendent of schools.
22	Law enforcement	All transactions concerning the county sheriff's office, including tax collection, and all justices of the peace and district court.
23	County roads	All transactions involved in construction and maintenance of county roads.

Sector number	Sector	Business types
24	Social services	All transactions of the county health department and welfare department, including Federal, State, and local. Also all salaries and office supplies of employees of county welfare department.
25	Administration	All transactions of the following county departments: assessor, treasurer, county commissioners, elections, county clerk, county surveyor, courthouse maintenance, planning commission, land agent, humane officer and department, veterans' service, and current expense account.
26	City of Roseburg	All transactions conducted by the City of Roseburg.
27	City of Sutherlin	All transactions conducted by the City of Sutherlin.
28	City of Myrtle Creek	All transactions conducted by the City of Myrtle Creek.
29	City of Reedsport	All transactions conducted by the City of Reedsport.
30	Other incorporated cities	All transactions conducted by the cities of Winston, Drain, Riddle, and Canyonville.
31	Households	Transactions by private individuals who are Douglas County residents.
32	Visitors	Purchases made by individuals not identified by the business operation as a county resident. This should include a major share of tourists and recreationists visiting the county.

APPENDIX B. Procedure for Calculating Impacts of Changes in Timber Availability

The input-output technique customarily assumes that the final demand for each industry is given and the industry responds to produce the level of total output that will meet the given level of demand. This is a reasonable assumption for the timber industry in Douglas County in the short-term situation. However, as the timber inventory of Douglas County declines, the output of the timber industry becomes more and more dependent on the public and private policy decisions that affect the level of harvest. It is therefore more realistic to assume that changes in the rate of harvest from one ownership will lead to equivalent changes in product output than to assume that compensating changes will hold output stable. Since no reliable estimate is available to show how the changes in resource availability would be distributed to the timber sectors (1, 2, 3, 4), these industries have been combined into one timber processing sector (1) in these analyses. The result is a 31x31 matrix of internal sectors as compared with the original 34x34 matrix.

In a situation where resource availability determines the level of industrial output for one or more sectors, the procedure for calculating the impacts of resource producing sectors must be modified. In the customary input-output formulation the inverse matrix is used to calculate the total outputs for all industries when the final demands for all industries are known. When one or more of the total outputs are known (from the amount of resource available), the equations with total output known must be solved simultaneously, using the total outputs for those sectors and the final demands for remaining sectors. Then the final demands for all sectors are used to solve for the total output of the remaining sectors.

There are four points where significant amounts of sales of stumpage (or logs) appear in our input-output matrices:

1. Sales between firms within the timber processing industry (1).
2. Sales by the Forest Service (19) to the timber processing industry (1).
3. Sales by the Bureau of Land Management (20) to the timber processing industry (1).
4. Imports of timber by the timber processing industry (1).

When we estimated the impact of a change in resource availability from one of the first three sources, we adjusted the technical coefficients so that as total output of the processing sector (1) changes, the purchase of stumpage from other sources could be held constant.

In order to estimate the impact of a change in timber availability from an ownership, we needed to know how much the change in timber availability would change wood consumption by the timber processing industry (1). Table 11 shows the timber harvest, production, and export volumes used in our analyses. When we changed timber availability from an ownership, we assumed that exports would change proportionately. For example, when timber harvest on private lands decreased 50 percent, we decreased exports from private lands 50 percent. Because exports were handled this way, a

Table 11.--Douglas County log flows used in input-output analyses [1]

Table 11.--Douglas County log flows used in input-output analyses [1]

(Million board feet, Scribner scale)

Timber source	Production in Douglas County	Consumption by Douglas County industry	Exports
Forest Service	337	212	125
Bureau of Land Management	340	303	37
Other public	20	20	--
Private lands	695	403	292
Imports	--	128	--
Total	1,372	1,066	454

[1] Volume estimates based on information from Youmans et al. (1973), USDA Forest Service (1962-71), and Manock et al. (1970).

50-percent reduction in private harvest caused an 18.9-percent reduction in consumption $(\frac{201.5}{1,066})$ rather than a 32.6-percent reduction $(\frac{347.5}{1,066})$. In our analyses, imports were assumed constant at 128 million board feet for each alternative.

Example: Calculating the impact of a 10 million-board-foot reduction in Bureau of Land Management timber harvest.

The following notation is used in our example.

Before harvest reduction	After harvest reduction	
Y_i	Y_i'	final demand for industry i
X_i	X_i'	total output of industry i
x_{ij}	x_{ij}'	sales of industry i to industry j or purchases of industry j from industry i
a_{ij}	a_{ij}'	technical coefficients
A_{ij}	A_{ij}'	coefficients in the inverse matrix

The following sectors were involved in allocating timber volumes.

Sector name:	industry i or j
Timber processing	(1)
Forest Service sales	(19)
Forest Service appropriations	(19a)
Bureau of Land Management sales	(20)
Bureau of Land Management appropriations	(20a)
Imports	(34)

We assumed that the proportion (0.109) of Bureau of Land Management sales exported would remain constant before and after the timber harvest decline. Therefore, consumption of Bureau of Land Management timber by the timber processing industry(1) should decrease by 0.891 (10 million board feet) or 8.91 million board feet. This amounts to 0.836 percent of the total timber consumption by the processing industry (1). Total output of the timber processing industries is therefore constrained to 99.164 percent of its previous level. A 10 million-board-foot reduction in Bureau of Land Management timber harvest would reduce the agency's harvest by 2.941 percent. Since exports are reduced proportionately, final demand for the Bureau of Land Management would decline by 0.02941.

We now have the necessary information to solve for the new technical coefficients that will reduce Bureau of Land Management (20) timber sales to the processing sector (1) by 10 million board feet while holding other sources of raw material constant when total output of the processing sector (1) declines by 0.836 percent.

$$a'_{20,1} = \frac{x'_{20,1}}{X'_1} = \frac{\$14,513,512}{\$252,852,818} = 0.05740$$

$$a'_{19,1} = \frac{x'_{19,1}}{X'_1} = \frac{\$10,472,367}{\$252,852,818} = 0.04142$$

Since $\sum_{i=1}^{34} a_{ij} = 1$ and the same must hold for the a'_{ij}, we had to make appropriate reductions in other coefficients. The adjustments are made to the coefficients representing other sources of stumpage. The following tabulation shows the net change in technical coefficients which must be allocated to other timber supply sectors.

	Before harvest reduction	After harvest reduction	Difference
$a_{20,1}$	0.05864	0.05740	−0.00124
$a_{19,1}$	0.04107	0.04142	+0.00035
Net change			−0.00089

The net change of −0.00089 was allocated proportionately to the timber processing industry (1) and imports (33). The proportionate allocation was based on the amount sector 1 purchased from these two sectors before the reduction in Bureau of Land Management timber harvest. The following shows the adjustments made in the technical coefficients for the two sectors.

	Before harvest reduction	Allocation	After harvest reduction
$a_{1,1}$	0.09028	+0.00018	0.09046
$a_{33,1}$	0.34485	+0.00071	0.34556

Y'_{20} can now be solved directly since final demand remains a constant proportion of total output.

$$Y_{20} = \$1,880,770$$

$$Y'_{20} = (1\text{-proportionate reduction in BLM sales}) \; Y_{20}$$

$$Y'_{20} = (1\text{-}0.02941) \; Y_{20} = \$1,825,457$$

Y'_1 can be calculated with the following equation:

$$Y'_1 = \frac{X'_1 - \sum_{j=5}^{32} (A'_{1j} Y'_j)}{A'_{1,1}}$$

X'_i can then be calculated with the following equation:

$$X'_i = \sum_{j=1}^{32} A_{ij} Y'_j$$

Following is a summary of the calculations for all resource constrained changes in total outputs, technical coefficients, and final demand.

Industry i or j	Before change in timber harvest	After 10 MM-board-foot reduction in BLM timber harvest	After 10 MM-board-foot reduction in FS timber harvest	After 50-percent decrease in private harvest, volume from other ownerships constant	After 50-percent decrease in private harvest, offset by increase in FS and BLM harvest
Total output (X) in $1,000					
Processing sector (1)	254,984	252,853	253,480	206,792	254,984
Forest Service (19)	16,698	16,698	16,203	16,698	23,227
Forest Service (19a)	8,659	8,659	8,659	8,659	12,045
Bureau of Land Management (20)	16,855	16,359	16,855	16,855	23,445
Bureau of Land Management (20a)	1,531	1,531	1,531	1,531	2,130
Technical coefficients (a)					
Processing sector (1)	.09028	.09046	.09041	.08546	.08219
Forest Service (19)	.04107	.04142	.04009	.05064	.05713
Bureau of Land Management (20)	.05864	.05740	.05899	.07231	.08157
Imports	.34485	.34556	.34535	.32643	.31395
Final demand (Y) in $1,000					
Processing sector (1)	224,657	222,771	223,328	179,964	224,412
Forest Service (19)	6,127	6,127	5,974	6,127	8,522
Bureau of Land Management (20)	1,881	1,825	1,881	1,881	2,616

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Darr, David R., and Roger D. Fight
1974. Douglas County, Oregon: Potential economic impacts of a changing timber resource base. USDA For. Serv. Res. Pap. PNW-179, 41 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oreg.

An input-output technique was used to estimate for each local sector the impact of the following on sales: Change in demand for forest products; change in Forest Service or Bureau of Land Management appropriations; changes in private, Forest Service, or Bureau of Land Management timber harvest; and a decline in private harvest offset by an increase in Forest Service and Bureau of Land Management harvest.

Keywords: Resources (forest), forest product industry development, economics (forest products industries).

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The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.
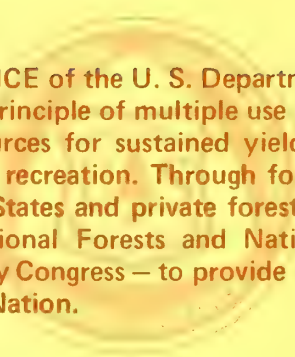
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2. Development and evaluation of alternative methods and levels of resource management.

3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

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